Glasses/lithography

John Spence, Arizona State University, DMR-0245702

Glasses play a vital role in modern technology, from fibre-optics communication to dielectrics and optical windows. Ordering in glasses forms "the most important outstanding problem in solid state physics" (P. Anderson). We have developed methods for studying this order using near-edge spectroscopy with a sub-nanometer electron beam. We have also developed a method of direct-write inorganic lithography based on doped glasses using the same 0.5nm diameter electron probe of an electron microscope. By this means we can make structures on the 0.5nm scale for quantum computing, quantum dot, optical and "squid" applications. We are also attempting to make structures with negative refractive index and other interesting photonic optical properties. New theoretical methods have been used to calculate the optical properties of these "designer dielectrics"

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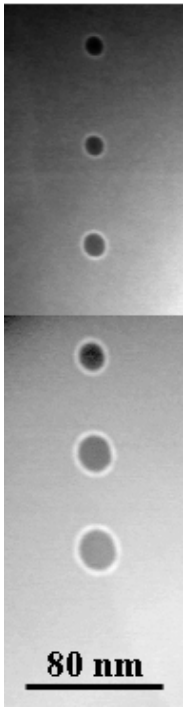

Nanorings in SiO_2 glass. Note scale. White circle is germanium nanoring "written" with 0.5nm diameter electron probe within a thin slab of silicate glass. We are also making nanorings of solid Metal (plasmon signature). These scatter colored light, like cathedral windows.

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Education and Outreach

This award was made in May 2003. Our program of outreach includes

1. Arrangements made with the Arizona Science Center in Phoenix (Dr L. Martin) for demonstrations (eg demonstration that all of the Encyclopedia Britannica could be written on a pinhead our method in nanometer lettering).

2. Plans to include a poster display of lithographic techniques ("Room at the bottom") in Prof. Jim. Mayer's "Patterns in Nature" mobile minibus tours of local high schools.

3. Inclusion of our work in the "Science for fun" program at ASU. This brings local high school students to ASU physics dept for open days.